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ABSTRACT

Bela Bartok's study of Turkish folk music classification was analyzed using permuted indices by means of GRIPHOS computer programs. A data base was constructed which would allow retrieval of information in terms of theme locater and first text-line indices. Data bases of tabulations much like the kind Bartok manually assembled were created to test the efficacy of this type of computerized research. Permutations not considered by Bartok but obtainable from GRIPHOS were also tested. Eighty-seven melodies and their texts yielded 73 units of information which were studied using the computerized system. (CH)

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A GRIPHOS Application of Bartók's Turkish Folk Music Material

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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A GRIPHOS Application to Bartók's Turkish Folk Music Material

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Béla Bartók, one of Hungary's greatest creative minds, is counted among the relatively few composers who have made significant contributions to the Western art music repertory. Ethnomusicologists recognize also the equally significant contributions Bartók made as a pioneer in the comparative study of musical folklore.

A few years before Bartók died in 1945 he wrote a scholarly essay on Anatolian folk music he had collected in 1936, which was completed in 1943 and titled *Turkish Folk Music from Asia Minor*. Bartók was unsuccessful in his attempts to find a publisher, and he deposited a copy of his manuscript at the Music Library of Columbia University. It was not until 1971 that his Turkish material could be made ready for press, since more urgent matters as well as other unpublished works had to be tackled first.[1] Meanwhile, however, the opportunity arose to provide Bartók's study with scholarly apparatus in the form of permuted indices, by means of GRIPHOS programs developed by Professor Jack Heller of the State University of New York at Stony Brook.[2] These permutations and the approach to the construction of the data base from which they were derived are the subjects of this essay.

The first step of course is to determine what kind of data are needed and in what form they are to be retrieved. In the present instance this determination already had been pointed to by Bartók, by way of the abundant data in well-organized form that appear in his studies of Slovak, Hungarian, Rumanian, and Serbo-Croatian folk music. The apparatus includes classification tables, lists of melodic and textual variants, performers' data, and frequency of occurrence statistics. Other useful tools, infrequently provided by Bartók and then only during collaborative research, are theme locator and first text-line indices.

It was therefore decided to construct a base of that data which would allow retrieval of information in the shape of theme locator and first text-line indices, for publication purposes; of tabulations in approximation of the kind Bartók had manually assembled, to test the efficacy of this type of computerized research; and of permutations not previously considered by Bartók but that could be obtained from the GRIPHOS system, as a possible contribution to ethnomusicological research method.

Analysis of Bartók's Turkish manuscript (see Figure 1) indicated four areas of concern: the melodies and their morphology; the poetic texts and their translations; data regarding performance; and general aspects of the collection. The eighty-seven melodies in the compilation, other than nine instrumental pieces, consist of vocal tunes and their texts, and they yielded seventy-three units or classes of information. These units, arranged by category and described by arbitrarily selected annotation numbers from 01 to 813, are shown in Figure 2.

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[1] For example, Bartók's monumental study *Rumanian Folk Music* (edited by Benjamin Suchoff, text translations by E. C. Teodorescu, with a Foreword by Victor Bator), in three volumes, which he began in 1933 and completed in 1945, was published in 1967 by Martinus Nijhoff, The Hague. Revised editions of his earlier books on Rumanian Christmas songs (1935) and the folk music of the Rumanians in Maramureş County (1923), which will complete Bartók's publications on Rumanian ethnomusicology, are to be published by [illegible] in 1975. The Turkish book, edited by the present writer, with an Afterword by Kurt Reinhard, also will be published in 1975 by the Princeton University Press.

[2] GRIPHOS is the acronym for *G*eneral *R*etrieval and *I*nfor[illegible]ation *P*rocessor for *H*umanities–*O*riented *S*tudies. Special acknowledgement is made here to Dr. Heller whose support and encouragement provided the impetus for the writing of this essay.

♪=400
yağ-ka-nip gal - - - dĭ-ğim se-nin yüzünde-ğe-a
Üç beş se-ne-ye bek-le - - - ye-bil-dim ka - - ci-nĭ
♪=464.
4 Ya-ra-ca Oğ-lan der de: yağ-ka-dım, gal-dĭm,
Mu-hab-bet ne - - - yi-miş ye-ni-ce bil-dim,
♪=380
Kim-se dah-ket - me-sin: mi-ni-den al-dĭ-ya-m
Üç beş se-ne gü-zel - - le-rin pa-cĭ-nĭ - - - a.

M. F. 3188, Tüysüz (Seydam), Bekir oğlu Mustafa (15), ill., of the Teceli tribe, 24.XI.1936

12.

1-9, 11[6+4+1],

♪=260
1. Din-le-yin a-ğa-la-yan be-zim sö-zü-mü,
Has bah-ça-ni-çin-de gül om-nim oğ-lu-n;
Em - nim oğ-lu-a-ta-ba-sĭn çek-miş gi-di-yor,
Bu ga-za-ya-zal-lahdan bi-ke-nem oğ - lum.

Figure 1. Page from Bartók's *Turkish Folk Music from Asia Minor* manuscript. Reproduced by permission, Estate of Béla Bartók.

Data Regarding the Collection

01	:	Melody Number
02	:	Title of the Collection
03	:	Author of the Collection
04	:	Editor of the Project
80	:	Editor's Remarks

Data Regarding Morphology of the Musical Material

20	:	Number of Melody Sections
21	:	Metric Structure
22	:	Syllabic Structure
23	:	Rhythmic Character
24	:	Caesuras
25	:	Range
26	:	Scale System
27	:	Content Structure
28	:	Class
29	:	Meter
30	:	Tempo
51	:	Pitch Designation

General Information Regarding the Melodic Material

40	:	Genre
49	:	Accompaniment
50	:	Melodic Variants
70	:	Author's Notes to the Melodies
71	:	Peculiarities of Performance

Data Regarding Morphological Specifics

101	:	First Melody Section Encoded in DARMS
201	:	First Melody Section Converted to Signed Digits
301	:	First Melody Section Content Structure
401	:	First Melody Section Syllabic Structure
501	:	First Melody Section Caesura
601	:	First Melody Section Meter

Data Regarding the Texts and their Translations

45	:	Text Class
46	:	Text Number
47	:	Text Variants
75	:	Author's Notes to the Texts
77	:	Rhyme Schema
701	:	First Section Turkish Textline
711	:	First Turkish Refrain
801	:	First Section Textline Translation
811	:	First Refrain Translation

Data Regarding Performers, Areas, and Recordings

60	:	Record Number
61	:	Date of Recording
62	:	Name of Performer
63	:	Performer's Sex
64	:	Performer's Age
65	:	Village of Recording
66	:	County of Recording
67	:	Miscellaneous Performer's Data

Figure 2. Description of annotation classes derived from Bartók's Turkish folk music material.

After determination of units has been made, a mimeographed form is prepared for extraction of data. Since Bartók's Turkish material is based on eighty-seven melodies, in numeric order as designated by the author, the melody numbers were chosen as item or record identifiers. Thus the complete file comprises eighty-seven items, each item containing a maximum of seventy-three individually numbered units. It should be noted that any unit can be repeated with different data, for example, where a separate listing of co-authors is desired rather than a composite entry. Figure 3 illustrates the format of data extraction for the first item: unit Nos. 01–30. The logical 'not' sign is used as the field tag immediately following each annotator.[3]

The GRIPHOS system employs a special print train, containing 155 characters, that provides upper and lower case, diacritical marks, Cyrillic letters, superscript characters, and other special features (Figure 4). This train was designed for the United Nations, for index permutation in English, French, Russian, and Spanish. Certain features are also useful in ethnomusicological printout, particularly in the case where Bartók created a special system of signs and symbols to be added to the standard music notation of his folk music collections.

Data extraction includes the encoding of melody beginnings. For this purpose a system developed by Stefan Bauer-Mengelberg, whose acronym is DARMS (*D*igital *A*lternate *R*epresentation of *M*usic *S*ymbols), is used. Pitches are indicated by numbers, rhythmic values by mnemonics, and so forth.[4]

The input medium is the punched card, since the data deck can serve as a hard copy reference file as well as insurance against accidental loss or erasure of magnetic disc or tape. Card images of the complete file are generated for proofreading purposes, then the corrected deck is given a final proofreading in item form. Figure 5 demonstrates the first item displayed for examination. Note that diacritics have not yet been entered (¢02 indicates that an acute accent is to be printed above the following character) and that the underline preceding a surname represents a sorting convention in which the given name will be transposed and a comma added to the surname.

All items and their units are carefully checked for errors. The corrected deck is then treated for GRIPHOS data base construction: units and their items are loaded on disk and provided with addresses. During this procedure a special program converts DARMS-encoded incipits to strings of signed digits, that is, ascending or descending pitch difference between two adjacent tones is calculated and printed as a plus or minus number. Figure 6 shows the frequency dictionary for annotation class 101 (music representation) and for its converted form as annotation class 201 (interval sequence). The first column shows the number of occurrences of unit types, the second column displays the unit, and the last column indicates the item address at which the unit is located. It should be noted that converted units are displayed in lexical order, that is, the interval sequences are sorted throughout the file so that plus precedes minus and lesser precedes greater digit. In other words the form is that of a theme locator index with respect to the first melody sections of the vocal material in Bartók's Turkish folk music collection.

The frequency dictionary mentioned above provides a unit count for each annotation class in the file. The complete list therefore offers another approach to detection of data errors (all data in the base can be enlarged, deleted, or replaced at any time), to determination of the number and kind of units in the file, and to statistical analysis of content. Examination of the frequency dictionary for annotation classes reveals interesting frequency of occurrence figures that are useful to the ethnomusicologist in describing the morphological features of the material at hand. Bartók's Turkish folk songs, for example, are predominantly four-section melodies, isometric, eight or eleven syllable structure, *parlando* rhythmic structure, wide in range, and so forth. Threse findings are identical with Bartók's own conclusions.

[3] The double-equal sign (==) may also be used.

[4] See Bauer-Mengelberg, 1970. See also Suchoff, 1969.

BARTÓK ARCHIVES TURKISH FOLK MUSIC PROJECT

Description	Data Regarding the Collection	Annotator
Melody No.	*1.*	01¬
Title	*Turkish Folk Music from Asia Minor*	02¬
Author	*Béla Bartók*	03¬
Edito	*Benjamin Suchoff*	04¬
Sections	*4*	20¬
Metric Structure	*Isometric*	21¬
Syllabic No.	*8, (8,8,8,6,)*	22¬
Rhythmic Character	*Parlando*	23¬
Cæsuras	*5) (3–) (3–*	24¬
Range	*1–7*	25¬
Scale System	*Dorian*	26¬
Content Structure	*A B C D*	27¬
Melody Class	*1*	28¬
Meter	*none*	29¬
Tempo	*16th=276*	30¬

7

Figure 3. First page of completed data extraction form for the first item.

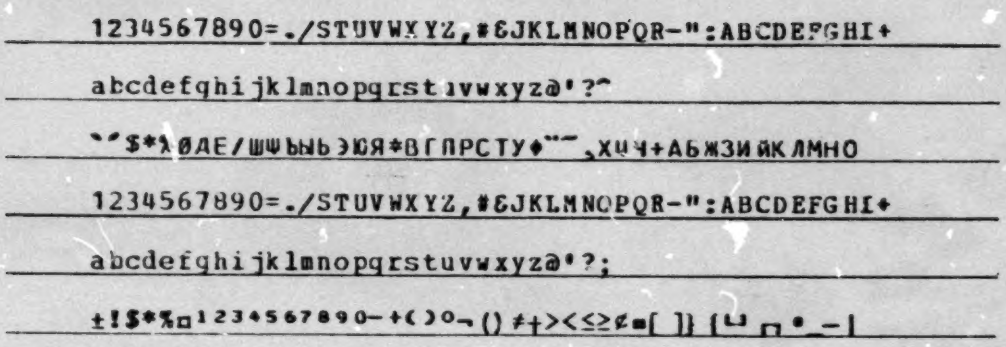

Figure 4. Character display from the GRIPHOS print train.

6e 9 8–s 7h. / 7s. 8*. 9e 7q.j / hj / 101¬ 8–s. 9 8 7h.. / 6s 6t 5–e 5h. rq. / 102¬

8–s 7e 8 6hj sj / 6e t 6 5–. rs / 103¬ 5–e. ts 3hj / 3e 3wj qj re. / 104¬ 1a. 01¬

Turkish Folk Music from Asia Minor 02¬ Bɕ 02ela_Bartɕ 020k 03¬ Benjamin_Suchoff 04¬ 4 20¬

isometric 21¬ 8, (8, 8, 8, 6,) 22¬ parlando 23¬ 5) (3–) (3– 24¬ 1 – 7 25¬

Dorian 26¬ ABCD 27¬ 1 28¬ 16th = 276 30¬ Nenni = Cradle song (Lullaby) 40¬

1a. 46¬ f* 51¬ m.f. 3156 b) 60¬ 20/11/1936 61¬ Zekeriye_Culha 62¬

male 63¬ 23 64¬ Kara Isalɕ23i 65¬ Seyhan 66¬ Illiterate 67¬

Latent pentatonic structure in Class 1 melodies 70¬

Prevalent so-called "descending" structure of the melodic line in Class 1 melodies 70¬ aaa 77¬ A 301¬

B 302¬ C 303¬ D 304¬ 8, 401¬ 8, 402¬ 8, 403¬ 6, 404¬

5) 501¬ (3–) 502¬ (3– 503¬ Daɕ26uulcular dama doldu, 701¬

The drummers filled up the house-roof, 801¬

Nenni yaɕ03urum, neni,/ Yedi yɕ23ilda bir buldugum,/.Nenni guzum, nenni. 711¬

Lullaby, my little one, lullaby, Whom I found seven years past,/Lullaby, my lamb, lullaby, 811¬

Figure 5. First item displayed for proofreading (see Figure 2 for explanation of annotators).

Annotation Class 101

1	re 5s 7 7e 7 / 7s 7e. 7s 7e. / 8 8 7q /	210
1	rs 3s 5– 7e 7 rs / 7e 7 6q /	187
1	2e 4–q 6h. 5– / 7e 6h 5–hj ej 3h. rq /	253
1	2e 6 5–q. 5e.. / 6e 5–h 4qj sj 2e. rq. /	259
1	3e 4 3q 3e re / 3 4 3q 3e re /	235
1	3e 4 6 5–j wj / 6e 5–h rq /	241
1	3e 6 4–q 4j sj / 6e 4–h. 3q 3e. re. /	255
1	3e 6 5–h 6qj e.j / 6e 5–qj sj 4–q 3e. rs. /	257
1	3e 6q 6e 6q / 6s 6q 6s 6q. /	178
1	3e 6s 6e 6 / 6 6 3q / 6s. 7. 7e 6s / 6e 5–s. 4e.. /	264
1	3q. 6s 6 6 /. 6 6e 6s 6 /	158
1	3q 3e 8– / 7 7 7q / 8–e 7 6 7 / 7hj ej /	270
1	30e. 31t 30s 30e 30 30wj sj re. / 32–e 31s 30 30 rt	69
1	30e 30 30 / 30 30 30q / 9s 7wwj h.j / 6s 7 5–q. rq.	170
1	30e 30 30s. 30q.. / 9s. 30. 9 7q. /	9
1	30e 30q. 30h / 30e 9q. 9e 8 re /	191
1	30e 30s 30 30 30 30e / 30q 30e / 8–s 8e. 6h.. rq. /	73
1	30e 31. 31 30wj qj / 30e 9*h. j s. j 8e 7h.. / 30e	122

1	−2−2−2	119	
1	−2−2+3−3−2+2	59	
1	−2−3−2+2−3	170	
1	+3	183	
1	+3+2−2	210	
1	+3−2+2	144	
1	+3−2−2	107	
2	+3−2−2−2	32	100
1	+3−2−3	77	
1	+3−2−3−2	174	
1	+3−2−3+4−2−3	238	
2	+3+3−2	21	187
1	+3+3−2+3−2−2−3	253	
1	+3−3+3−2+2−3	93	
1	−3	251	
1	−3+3−2−2	215	
1	−3−3	73	
1	−3−4+4	230	
2	+4	158	178
1	+4+2−2−2−2+2−2−2	267	
1	+4−2+2−2−2−2	257	

Figure 6. Extracts from frequency dictionary for annotation classes 101 and 201. Compare items 158 and 178 in both classes.

Another practical aspect of GRIPHOS data base construction is index permutation for editorial purposes. Figure 7 shows a portion of the theme locator index which was prepared as an appendix to Bartók's study. This index, comprised of all melody sections of different content structure, displays current index number, interval sequence, classification number, melody number, and section content structure. The appearance of double quotes serves as a signal that the matched strings may represent variant relationships in the same or in different classification groups of the melodies and, moreover, that the first (second, third, and fourth) melody section of a folk song may have the same content structure as the first (second, third, or fourth) melody section of other pieces in the same collection.

Other indices produced from the data base as editorial supplements include an index of first lines, Turkish and English, and a list of Turkish refrains and their translation.

In order to test the efficacy of the GRIPHOS system a permutation was programmed in approximation of a procedure followed by Bartók for his study of Serbo-Croatian folk songs in 1942. He drafted a tabulation of his material for classification purposes, in which various morphological aspects and marginalia appear in great detail.[5] Figure 8 presents a portion from the tabulation of Turkish material derived from the data base.

Another permutation, not shown here, duplicated a table constructed by Bartok to display the statistical data concerning counties, villages, and performers in the above-mentioned study of Serbo-Croatian folk songs.

The last example is an extract from a comparative survey of melody–text structural attributes (Figure 9). The idea for this permutation of data sprang from examination of the frequency dictionary for content structure (class 27) and rhyme schema (class 77).

Annotation Class 27	
1	A B (?) (?)
1	AA
2	AAAB
1	AAB
1	AABA
3	AABB
8	AABC
5	AB
2	ABB
1	ABBB
4	ABBC
5	ABC
26	ABCD

Annotation Class 77	
4	aaa
6	aaa + refrain
1	aaaa
21	aaab
29	aaba
1	abab
14	No regular rhyme formation

[5] Bartok prepared the tabulation for inclusion in B. Bartok and Albert B. Lord, *Serbo-Croatian Folk Songs* (Columbia Univ. Press, New York, 1951). For certain reasons, however, it was excluded from the publication.

55	+–2–2–2	10	34.	A
56	"	13	40.	B
57	+2–2–2–2–2	1	1a.	B
58	"	"	8d.	C
59	"	2	12.	B
60	"	"	17c.	D
61	"	"	21a.	C
62	"	5	29.	B
63	+2–2–2–2–2–2	2	17a.	C
64	"	"	17b.	C
65	+2–2–2–2–2–2–4	2	10a.	A
66	+2–2–2–2–2–3+2–3	2	22.	D
67	+2–2–2–2–2+4	3	24.	A
68	+2–2–2–2+3+2–2–2–2	2	12.	C
69	+2–2–2–2–3	1	8a.	C
70	+2–2–2–3	1	1b.	B
71	+2–2–2–3–2	5	28.	B
72	+2–2+3–2–2	2	13b.	A

13

Figure 7. Extract from permuted lexicographical index of vocal melodies from Bartok's *Turkish Folk Music from Asia Minor.*

Melody No.	Class	Section Structure	Syllable Structure	Caesuras	Range	Content Structure	Genre, Melodic Variants, and Peculiarities of Performance
21a.	2	4	11, (6+4+1)	8) (4) (4	1 – 10–	ABCD	
21b.	2	4	11, (6+3+2)	8) (5) (4	1 – 11	ABCD	Hiatus-filling consonant: ñ türkmeni (in Seyhan)
							Bozlak (?)
22.	2	4	11, (4+4+3)	10–) (6–) (8		ABCD	Hiatus-filling consonant: y
							Color vibrato produced by the tongue
23.	2	4	11,	7) (7) (3–	1 – 10–	AABC	
24.	3	3	11, (4+4+3,6+4+1)	5) (5)	1 – 9	AAB	Hiatus-filling consonant: n Aşiret gaydasi = melody of the Aşiret
25.	4	2	8,	(1)	VII – 4	AA	Agit = Mourning song
							Hiatus-filling consonant: ñ
							Color vibrato produced by the tongue
26.	4	2	8,	(4)	1 – 9	AB	Maraş – dance designation
27.	5	2	11, (6+2+3)	(1)	1 – 7	AB	
28.	5	2	11, (6+3+2)	(4)	1 – 9	AB	

Figure 8. Page from Tabulation of Turkish Material.

A B (?) (?)	No regular rhyme formation	13b.	30e. 31t 30s 30e 30 30wj sj re. / 32–3 31s 30 30	+2–2+3–2–2
			7s 7t 7s 7q. 6s 5–e. / 6s 6 6. 7 / 3wj qj sj rq..	–2–2+2+2–5
AA		25.	5–e 6. 5q. 6j sj / 5–e 6 h.h. re /	+2–2+2–2+2
AAAB	aaab	10a.	32–q 32e 32 33 32s 32q. / 31e. 30 9 8– / 5–q rw /	+2–2–2–2–2–2–4
			3e 30. 30s. 9e 30 9 8– / 7s. 6. 5–w..j q..j / 6q	+2–2+2–2–2–2–2–2+2
"	aaba	8e.	8e 9s 30q 30h / 30e 30 9 7hj ej rs /	+2+2–2–3
			6q. 7e 5–q. 6e / 4q. 5–e 3q 3h re rh /	+2–3+2–3+2–3
AAB	aaab	24.	30e 31. 31 30wj qj / 30e 9eh. j s.j 8e 7h.. / 30e	+2–2–2–2–2+4
			6e 7 7 6h / 6s 4h. re / 5–3 5 4 3s. / 3h. rh re /	+2–2–3+2–2–2
AABA	aaba	43b.	31e 30j hj 31e 3q. / 31s 30e.j q.j 8e rq. /	–2+2–2+2–2–2
			5–s 6 7 7h / 8–e 8q. 7e rq. / 5–e 6 7 7h / 8–e 8h	+2+2+2–2–3+2+2

Figure 9. Extract from an index of melody–text structural attributes.

Note that Bartók uses capital letters to designate melody sections of different content structure and lower case letters for text lines of different rhyme. Is there any relationship between melody stanza content structure and text stanza rhyme schema? Analysis of the permuted data in the complete printout indicates that only melody Nos. 10a. (AAAB/aaab) and 43b. (AABA/aaba) show the same change in content of their melody sections as in rhyme of their underlying text lines. Thus a conclusion can be drawn that the relationship between content structure and rhyme schema is not a characteristic feature of Bartók's Turkish folk music material.[6]

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[6]This paper, edited for publication, was read at the first International Conference on Computers in the Humanities, University of Minnesota, July 21, 1973.